charge in each of the columns is measured by the sensing circuit **76** to determine the positions of multiple objects when they touch the touch screen **70**.

[0061] **FIG. 6** is a partial top view of a transparent multiple point touch screen **100**, in accordance with one embodiment of the present invention. By way of example, the touch screen **100** may generally correspond to the touch screen shown in **FIGS. 2 and 4**. The multipoint touch screen **100** is capable of sensing the position and the pressure of multiple objects at the same time. This particular touch screen **100** is based on self capacitance and thus it includes a plurality of transparent capacitive sensing electrodes **102**, which each represent different coordinates in the plane of the touch screen **100**. The electrodes **102** are configured to receive capacitive input from one or more objects touching the touch screen **100** in the vicinity of the electrodes **102**. When an object is proximate an electrode **102**, the object steals charge thereby affecting the capacitance at the electrode **102**. The electrodes **102** are connected to a capacitive sensing circuit **104** through traces **106** that are positioned in the gaps **108** found between the spaced apart electrodes **102**. The electrodes **102** are spaced apart in order to electrically isolate them from each other as well as to provide a space for separately routing the sense traces **106**. The gap **108** is preferably made small so as to maximize the sensing area and to minimize optical differences between the space and the transparent electrodes.

[0062] As shown, the sense traces **106** are routed from each electrode **102** to the sides of the touch screen **100** where they are connected to the capacitive sensing circuit **104**. The capacitive sensing circuit **104** includes one or more sensor ICs **110** that measure the capacitance at each electrode **102** and that reports its findings or some form thereof to a host controller. The sensor ICs **110** may for example convert the analog capacitive signals to digital data and thereafter transmit the digital data over a serial bus to a host controller. Any number of sensor ICs may be used. For example, a single chip may be used for all electrodes, or multiple chips may be used for a single or group of electrodes. In most cases, the sensor ICs **110** report tracking signals, which are a function of both the position of the electrode **102** and the intensity of the capacitance at the electrode **102**.

[0063] The electrodes **102**, traces **106** and sensing circuit **104** are generally disposed on an optical transmissive member **112**. In most cases, the optically transmissive member **112** is formed from a clear material such as glass or plastic. The electrode **102** and traces **106** may be placed on the member **112** using any suitable patterning technique including for example, deposition, etching, printing and the like. The electrodes **102** and sense traces **106** can be made from any suitable transparent conductive material. By way of example, the electrodes **102** and traces **106** may be formed from indium tin oxide (ITO). In addition, the sensor ICs **110** of the sensing circuit **104** can be electrically coupled to the traces **106** using any suitable techniques. In one implementation, the sensor ICs **110** are placed directly on the member **112** (flip chip). In another implementation, a flex circuit is bonded to the member **112**, and the sensor ICs **110** are attached to the flex circuit. In yet another implementation, a flex circuit is bonded to the member **112**, a PCB is bonded to the flex circuit and the sensor ICs **110** are attached to the PCB. The sensor ICs may for example be capcitance sensing ICs such as those manufactured by Synaptics of San Jose, Calif., Fingerworks of Newark, Del. or Alps of San Jose, Calif.

[0064] The distribution of the electrodes **102** may be widely varied. For example, the electrodes **102** may be positioned almost anywhere in the plane of the touch screen **100**. The electrodes **102** may be positioned randomly or in a particular pattern about the touch screen **100**. With regards to the later, the position of the electrodes **102** may depend on the coordinate system used. For example, the electrodes **102** may be placed in an array of rows and columns for Cartesian coordinates or an array of concentric and radial segments for polar coordinates. Within each array, the rows, columns, concentric or radial segments may be stacked uniformly relative to the others or they may be staggered or offset relative to the others. Additionally, within each row or column, or within each concentric or radial segment, the electrodes **102** may be staggered or offset relative to an adjacent electrode **102**.

[0065] Furthermore, the electrodes **102** may be formed from almost any shape whether simple (e.g., squares, circles, ovals, triangles, rectangles, polygons, and the like) or complex (e.g., random shapes). Further still, the shape of the electrodes **102** may have identical shapes or they may have different shapes. For example, one set of electrodes **102** may have a first shape while a second set of electrodes **102** may have a second shape that is different than the first shape. The shapes are generally chosen to maximize the sensing area and to minimize optical differences between the gaps and the transparent electrodes.

[0066] In addition, the size of the electrodes **102** may vary according to the specific needs of each device. In some cases, the size of the electrodes **102** corresponds to about the size of a finger tip. For example, the size of the electrodes **102** may be on the order of 4-5 mm2. In other cases, the size of the electrodes **102** are smaller than the size of the finger tip so as to improve resolution of the touch screen **100** (the finger can influence two or more electrodes at any one time thereby enabling interpolation). Like the shapes, the size of the electrodes **102** may be identical or they may be different. For example, one set of electrodes **102** may be larger than another set of electrodes **102**. Moreover, any number of electrodes **102** may be used. The number of electrodes **102** is typically determined by the size of the touch screen **100** as well as the size of each electrode **102**. In most cases, it would be desirable to increase the number of electrodes **102** so as to provide higher resolution, i.e., more information can be used for such things as acceleration.

[0067] Although the sense traces **106** can be routed a variety of ways, they are typically routed in manner that reduces the distance they have to travel between their electrode **102** and the sensor circuit **104**, and that reduces the size of the gaps **108** found between adjacent electrodes **102**. The width of the sense traces **106** are also widely varied. The widths are generally determined by the amount of charge being distributed there through, the number of adjacent traces **106**, and the size of the gap **108** through which they travel. It is generally desirable to maximize the widths of adjacent traces **106** in order to maximize the coverage inside the gaps **108** thereby creating a more uniform optical appearance.

[0068] In the illustrated embodiment, the electrodes **102** are positioned in a pixilated array. As shown, the electrodes